

4. Locate the stopper arm onto the shift drum center (C, **Figure 12**) and tighten the stopper arm bolt securely.

5. Install the dowel pins (A, **Figure 6**), the bearing stopper plates (B, **Figure 6**) and the collars (**Figure 5**).

6. Compress the springs under the ratchet pawls and install the gearshift drum shifter and guide plate assembly (**Figure 13**). Install the bolts (**Figure 14**) and tighten securely.

7. If removed, install the shift collar (A, **Figure 4**) onto the pin on the drum shifter.

8. Make sure the small washer (**Figure 15**) is in place on the gearshift spindle.

9. Install the gearshift spindle assembly. Make sure the gearshift spindle assembly is correctly positioned onto the stopper plate (**Figure 16**).

10. Align the index mark on the clutch lever with the raised arrow on the crankcase and install the clutch lever (**Figure 17**).

11. Install the thrust washer (**Figure 18**) onto the clutch lever.

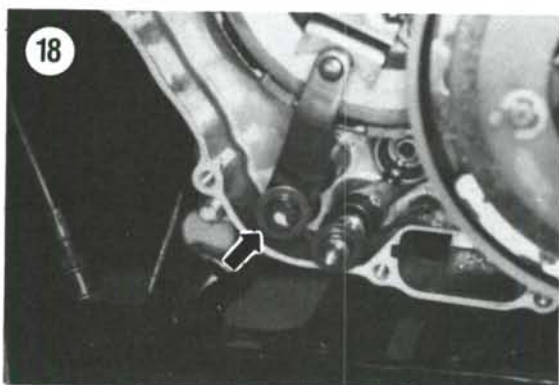
12. Install the right- and left-hand crankcase covers as described in Chapter Four.

13. Refill the engine with the recommended type and quantity of engine oil as described in Chapter Three.

14. Adjust the clutch as described in Chapter Three.

TRANSMISSION AND INTERNAL SHIFT MECHANISM

To gain access to the transmission and internal shift mechanism, it is necessary to remove the engine and split the crankcase. After the crankcase has been split, both transmission shafts must be disassembled within the crankcase—they cannot be removed intact. The output gear case can only be



removed after all gears have been removed from the countershaft.

Refer to **Table 1** for specifications on the transmission and **Table 2** for specifications on the internal shift mechanism.

NOTE

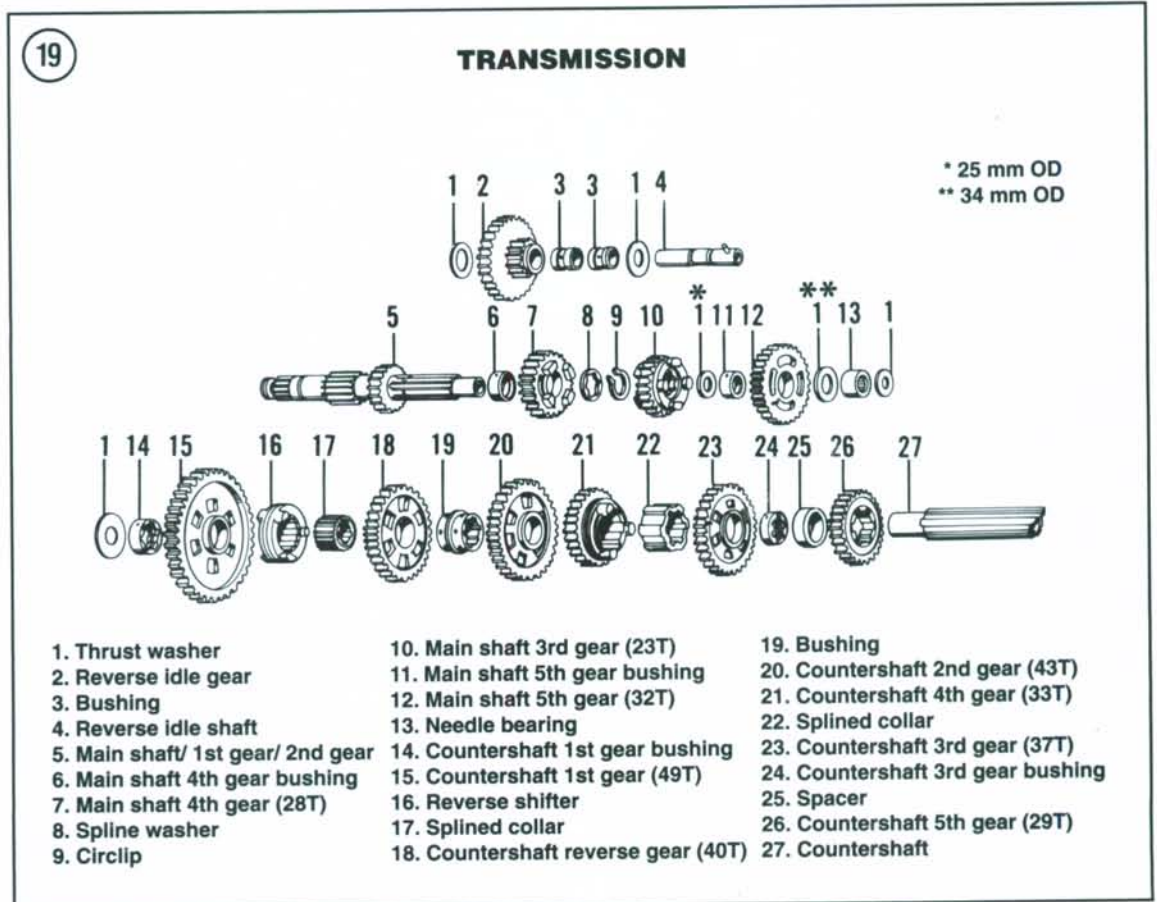
If disassembling a used, well run-in engine for the first time by yourself, pay particular attention to any additional shims that may have been added by a previous owner. These may have been added to take up the tolerance of worn components and must be reinstalled in the same position since the shims have developed a wear pattern. If new parts are going to be installed, these shims may be eliminated. This is something you will have to determine upon reassembly.

Removal and Disassembly

This removal and disassembly of the transmission shafts and the internal shift mechanism is quite different from the typical motorcycle or vehicle.

The gears and their related parts will be removed from *both* transmission shafts simultaneously. It is very important to keep the gears and related parts separated from each other so they won't get intermixed. Have 2 boxes or egg flats (the type restaurants get their eggs in) available for each transmission shaft. Mark the box or egg flat with either COUNTERSHAFT or MAIN SHAFT and make sure to place the removed parts into the correct box or egg flat.

In case some gears get misplaced or out of order, the description of the gears in the text and in **Figure 19** indicates the number of teeth (i.e., Countershaft 1st gear 49T) for each specific gear. Count the number of teeth on the gears and you should be able to sort out any mixed up gears.

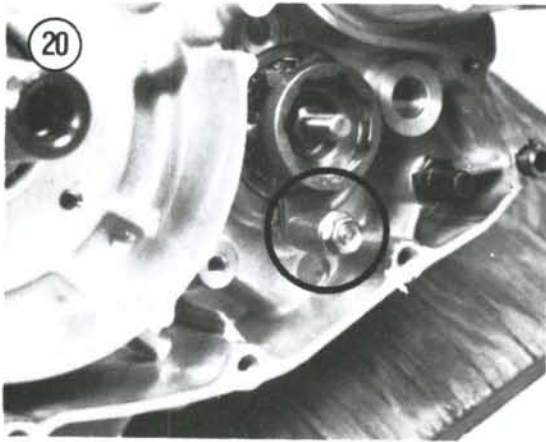


Refer to **Figure 19** for this procedure.

1. Remove the engine and split the crankcase as described in Chapter Four.

NOTE

Temporarily install one of the gearshift drum bearing stopper plates, dowel pins, collars and bolts (**Figure 20**) to keep the bearing from falling out of the crankcase.



2. Pull the shift fork shaft (**Figure 21**) out of the crankcase.

3. From the countershaft; slide off the thrust washer (A, **Figure 22**) and the countershaft 1st gear (B, **Figure 22**).

4. Slide off the thrust washer (**Figure 23**) and the reverse idle gear (**Figure 24**) and bushing.

5. From the reverse idle shaft, slide off the other bushing (**Figure 25**) and the thrust washer (**Figure 26**).

6. Remove the reverse idle gear shaft (A, **Figure 27**).

7. From the countershaft, perform the following:

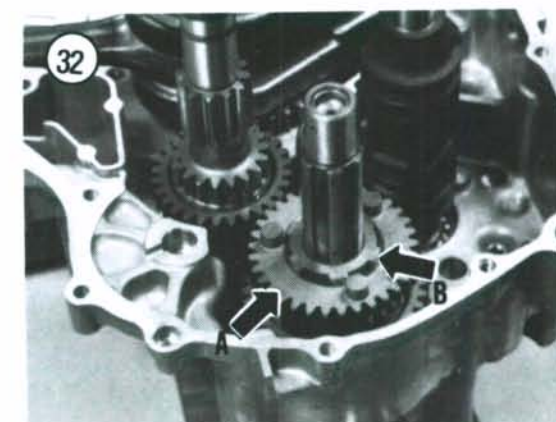
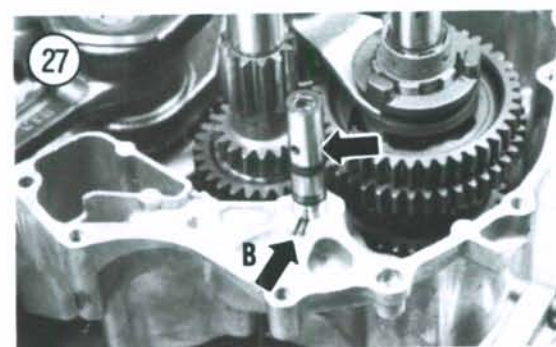
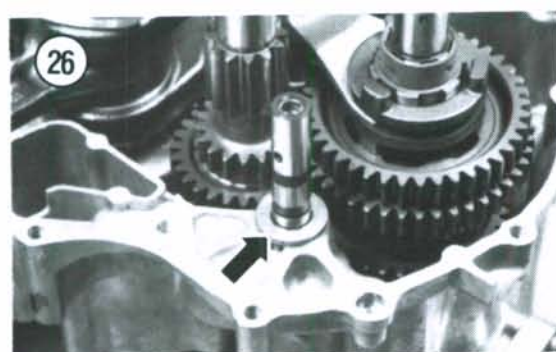
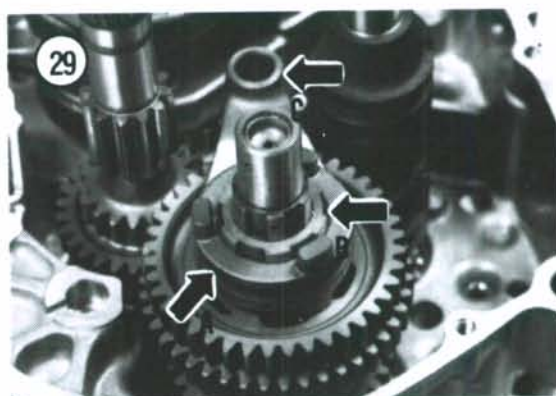
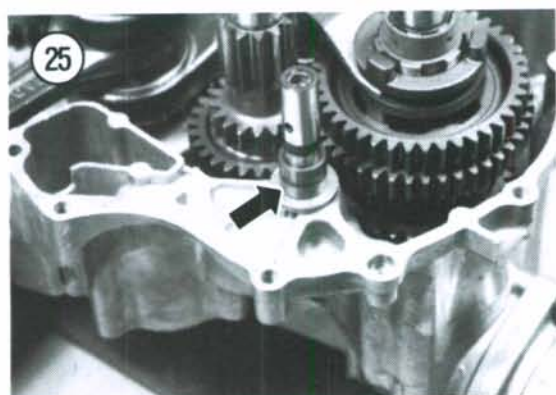
- a. Slide off the countershaft 1st gear bushing (**Figure 28**).

- b. Slide off the countershaft reverse shifter (A, **Figure 29**), the splined collar (B, **Figure 29**) and the shift fork (C, **Figure 29**).

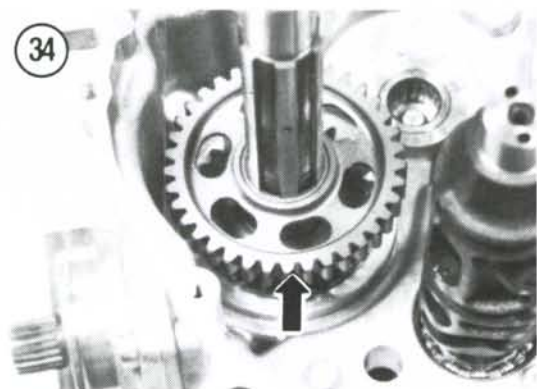
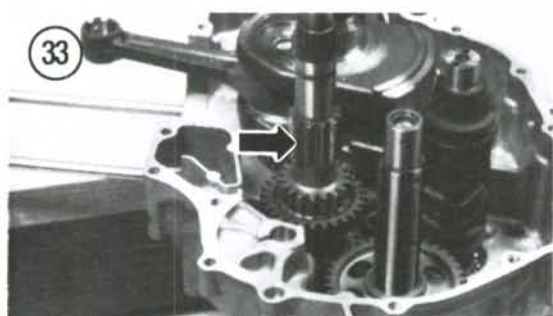
- c. Slide off the countershaft reverse gear (**Figure 30**).

- d. Slide off countershaft 2nd gear (A, **Figure 31**) and the countershaft reverse/2nd gear bushing (B, **Figure 31**).





- e. Slide off countershaft 4th gear (A, **Figure 32**), the splined collar (B, **Figure 32**) and the shift fork.
8. Remove the main shaft assembly (**Figure 33**). Not all main shaft gears will come out with the main shaft assembly at this time. Some will stay in the crankcase and are removed in the next step.
9. Remove the main shaft 3rd gear, thrust washer, 5th gear, 5th gear bushing and thrust washer that are sitting in the recess in the crankcase.
10. From the countershaft; slide off the countershaft 3rd gear (**Figure 34**), 3rd gear bushing (**Figure 35**) and the spacer (**Figure 36**).



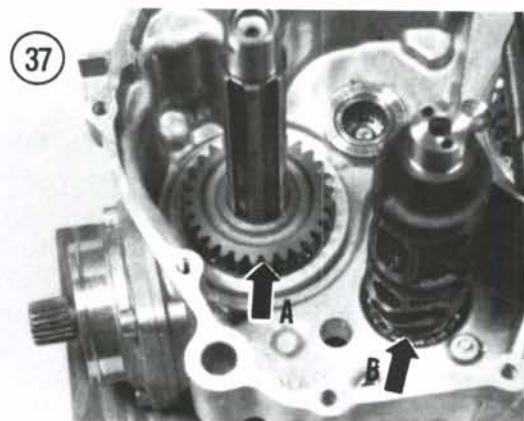
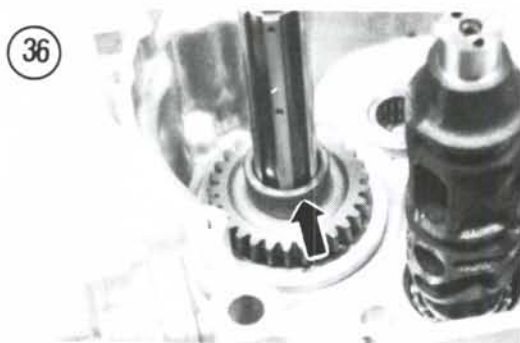
11. From the countershaft; slide off the countershaft 5th gear (A, **Figure 37**).
12. Remove the gearshift drum (B, **Figure 37**).
13. Remove the remaining gears from the main shaft as follows:
 - a. Remove the circlip and slide off the splined washer.
 - b. Slide off the main shaft 4th gear and the 4th gear bushing.
14. If necessary, remove the output case as described in this chapter.

Assembly/Installation

NOTE

It is a good idea to replace all circlips every other time the transmission is disassembled to ensure proper gear alignment.

1. If removed, install the output gear case as described in this chapter.
2. Assemble the main shaft as follows:
 - a. Slide on the thrust washer.



- b. Slide on the 4th gear bushing (**Figure 38**).
- c. Slide on the 4th gear (**Figure 39**), splined washer and install the circlip (**Figure 40**).

CAUTION

*There are 2 different size thrust washers used on the main shaft. In the following step, the outside diameter (OD) of the thrust washer is important and the correct one must be installed at this time. The outside diameters of the thrust washers are identified in **Figure 19**.*

- d. Position the main shaft 3rd gear (23T) with the round engagement dogs (A, **Figure 41**) facing away from the assembled shaft and install the 3rd gear.
 - e. Install the 25 mm OD thrust washer (B, **Figure 41**).
3. Coat all bearing and sliding surfaces of the shift drum with assembly oil. Install the shift drum (B, **Figure 37**) and rotate it to the neutral position. This will make it easier to insert the shift fork pin followers into the shift drum.
 4. Onto the countershaft, install the following:
 - a. Slide on the countershaft 5th gear (29T) (A, **Figure 37**).
 - b. Slide on the spacer (**Figure 36**).
 - c. Align the oil holes in the 3rd gear bushing with the oil hole in the countershaft and slide on the 3rd gear bushing (**Figure 42**).
 - d. Position the 3rd gear (37T) with taller boss facing up and slide on the 3rd gear (**Figure 34**).

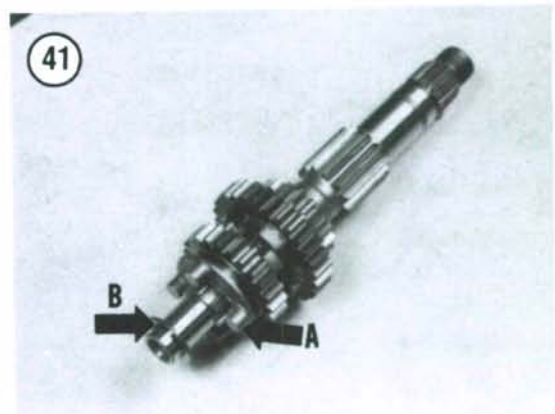
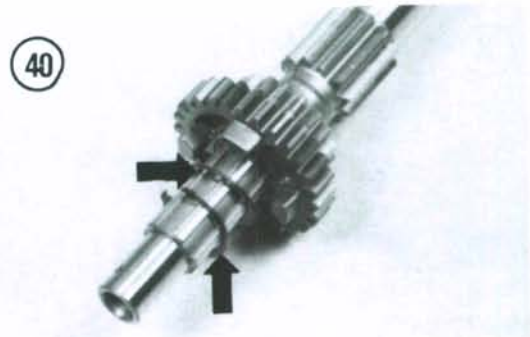
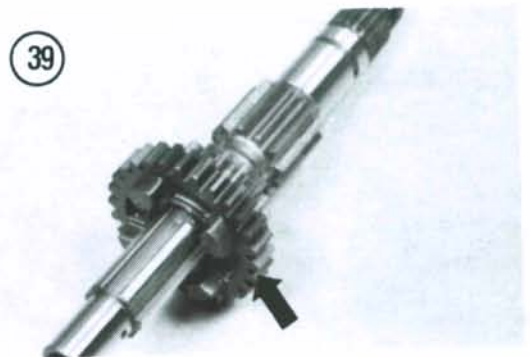
CAUTION

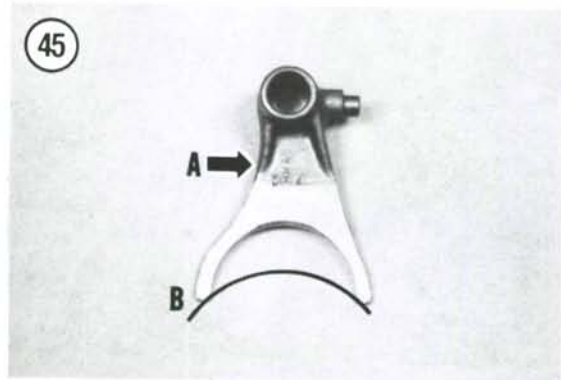
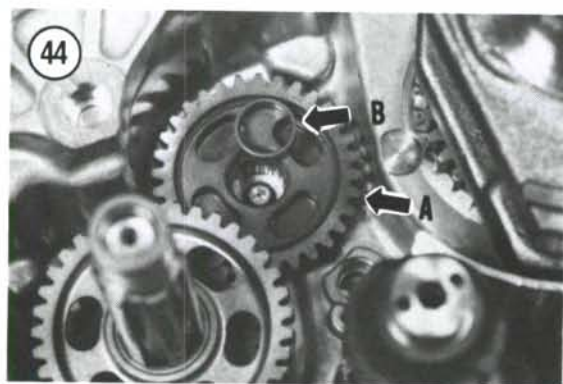
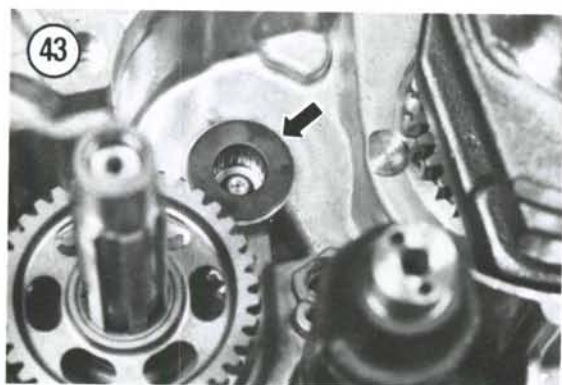
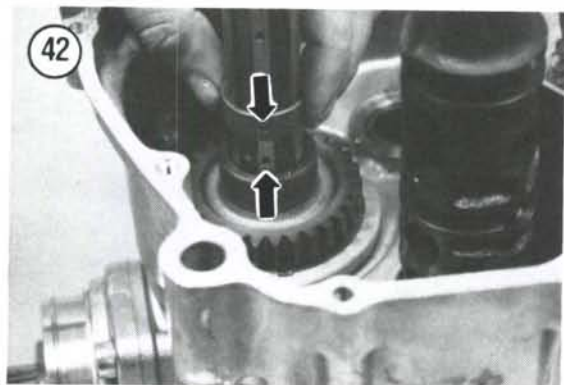
There are 2 different size thrust washers used on the main shaft. In the following step, the outside diameter (OD) of the

*thrust washer is important and the correct one must be installed at this time. The outside diameters of the thrust washers are identified in **Figure 19**.*

5. Into the recess in the left-hand crankcase, install the following main shaft parts:

- a. Install the 34 mm OD thrust washer onto the crankcase and align the hole in the washer with the bearing in the crankcase (**Figure 43**).
- b. Position the 5th gear (32T) with the engagement dog recesses up (A, **Figure 44**) and install the 5th gear.



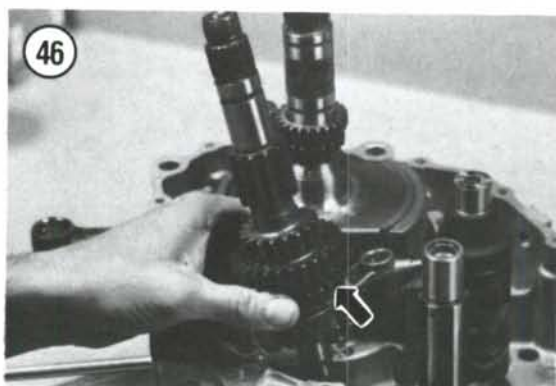


- c. Install the main shaft 5th gear bushing (B, **Figure 44**) into the 5th gear. The oil hole alignment is not necessary with the main shaft. Align the ID of the gear bushing with the bearing in the crankcase.
- d. Align *all* the holes in the previously installed parts so the mainshaft can be installed through the gears and thrust washers and into the needle bearing in the crankcase.

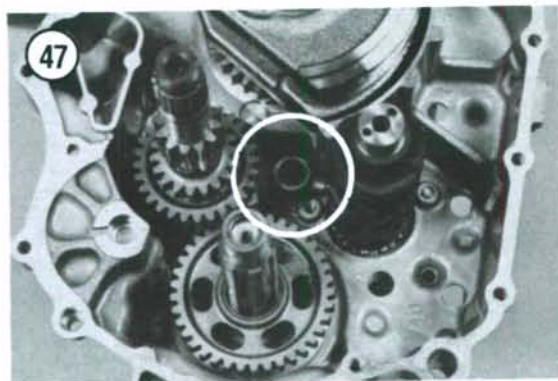
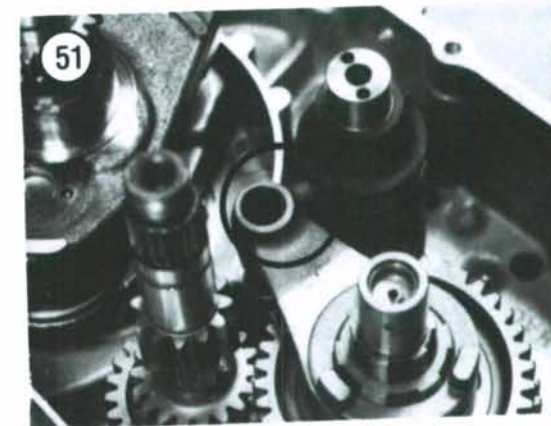
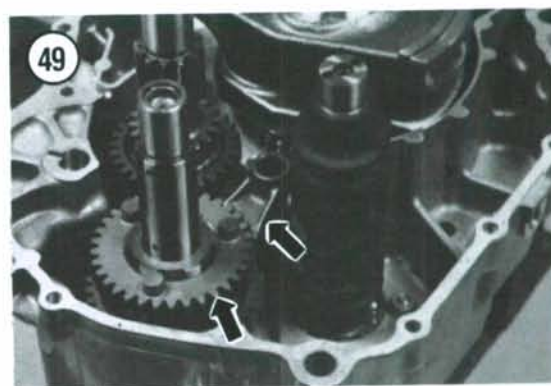
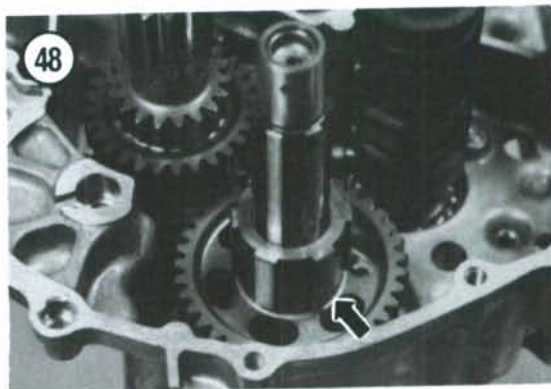
NOTE

*The shift forks are marked with a "L," "C" or "R." Install the shift forks with these marks facing UP (A, **Figure 45**).*

6. Position the "L" shift fork into the mainshaft (**Figure 46**) and install the main shaft assembly. Make sure the main shaft assembly passes through all of the previously installed parts on the left-hand crankcase. Make sure the shaft seats completely in the needle bearing in the left-hand crankcase half.
7. After the main shaft is installed; rotate the 3rd gear until its dogs are engaged in the dog recesses in the 5th gear. The 3rd and 5th gears must be so engaged so the main shaft assembly can move down into the crankcase, otherwise the rest of the transmission cannot be assembled correctly.
8. Move the shift fork into mesh with the shift drum (**Figure 47**).
9. Onto the countershaft, install the following:
 - a. Slide on the splined collar (**Figure 48**).
 - b. Position the center shift fork "C" into mesh with the 4th gear and slide on 4th gear (33T) (**Figure 49**).
 - c. Move the shift fork into mesh with the shift drum (**Figure 50**).
 - d. Position the 2nd gear with flush side facing up and slide on 2nd gear (43T) (A, **Figure 31**).



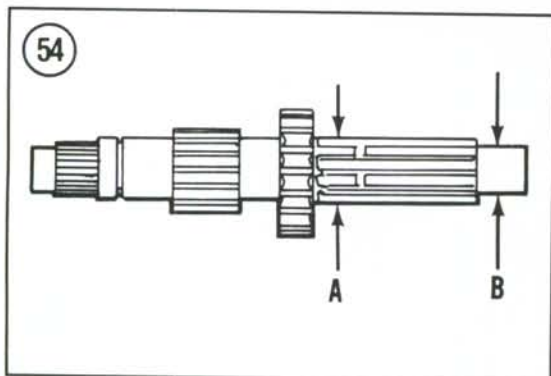
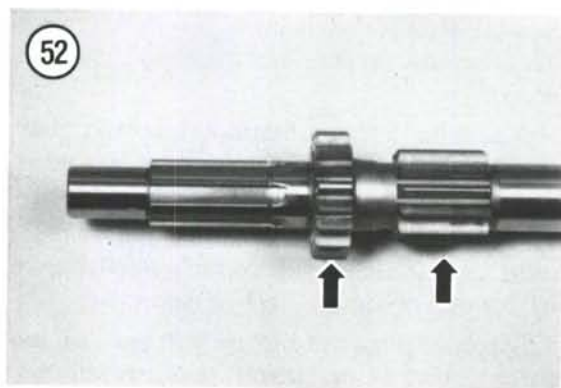
- e. Slide on the countershaft reverse/2nd gear bushing (B, **Figure 31**). The bushing is symmetrical and can be installed with either end in first. The oil holes in the bushing do not have to align with the oil holes in the countershaft.
 - f. Position the countershaft reverse gear with the flush side on first and slide on the countershaft reverse gear (40T) (**Figure 30**).
 - g. Position the center shift fork "R" into mesh with the reverse shifter (C, **Figure 29**).
 - h. Slide on the splined collar (B, **Figure 29**) and the countershaft reverse shifter (A, **Figure 29**).
 - i. Move the shift fork into mesh with the shift drum (**Figure 51**).
 - j. Align the oil hole in the 1st gear bushing with the oil hole in the countershaft (**Figure 28**) and slide the bushing into place.
10. Install the idle gear shaft (A, **Figure 27**) and position the locating pin into the recess in the crankcase (B, **Figure 27**).
11. Onto the reverse idle gear shaft, perform the following:
- a. Slide on the washer (**Figure 26**) and bushing (**Figure 25**).
 - b. Slide on the reverse idle gear and bushing (**Figure 24**).
 - c. Slide on the thrust washer (**Figure 23**).
12. Onto the countershaft, slide on the 1st gear (49T), 1st gear bushing (B, **Figure 22**) and thrust washer (A, **Figure 22**).
13. Align the holes in all 3 shift forks and install the shift fork shaft (**Figure 21**). Make sure all 3 cam pin followers are in mesh with the shift drum grooves.
14. Spin the transmission shafts and shift through the gears using the shift drum. Make sure you can shift



into all gears. This is the time to find that something may be installed incorrectly—not after the crankcase is completely assembled.

NOTE

This procedure is best done with the aid of a helper as the assemblies are loose and won't spin very easily. Have the helper spin the transmission shaft while you turn the shift drum through all the gears.



15. Assemble the crankcase as described in Chapter Five.

Transmission Inspection

1. Check each gear for excessive wear, burrs, pitting, or chipped or missing teeth. Make sure the lugs on the gears are in good condition.

NOTE

Defective gears should be replaced. It is a good idea to replace the mating gear on the other shaft at the same time even though it may not show as much wear or damage.

NOTE

On the main shaft, the 1st gear and the 2nd gear (Figure 52) are part of the shaft. If either gear is defective, the shaft must be replaced.

2. Check the inner and outer splines of the splined collars (Figure 53) for excessive wear or burrs. Replace as necessary.
3. Make sure that all gears slide smoothly on their respective shaft splines.
4. On the main shaft, make the following measurements:
 - a. Measure the outside diameter of the raised portion of the splines on the main shaft as shown in A, Figure 54 at the 4th gear location. Refer to main shaft dimension A in Table 1. If the shaft is worn to the service limit or less, the shaft must be replaced.
 - b. Measure the outside diameter of the main shaft as shown in B, Figure 54 at the 5th gear location. Refer to main shaft dimension B in Table 1. If the shaft is worn to the service limit or less, the shaft must be replaced.
5. Measure the inside diameter (A, Figure 55) of the following gears:
 - a. Main shaft gears: 4th gear, 5th gear.
 - b. Countershaft gears: 1st, 2nd, 3rd, reverse gear.
 - c. Reverse idle gear.

Refer to the dimensions in Table 1. If the gear(s) are worn to the service limit or greater, the gear(s) must be replaced.
6. Measure the inside diameter (B, Figure 55) of the following gear bushings:
 - a. Main shaft gear bushing: 4th gear, 5th gear.
 - b. Reverse idle gear.

Refer to the dimensions in **Table 1**. If the gear bushing(s) are worn to the service limit or greater the gear bushing(s) must be replaced.

7. Measure the *outside* diameter (C, **Figure 55**) of the following gear bushings:

- Main shaft gear bushings: 4th gear, 5th gear.
- Countershaft gear bushings: 1st, 2nd, 3rd, reverse gear.
- Reverse gear.

Refer to the dimensions in **Table 1**. If the gear bushing(s) are worn to the service limit or less, the gear bushing(s) must be replaced.

8. Measure the *outside* diameter of the reverse idle shaft at the reverse idle gear location (**Figure 56**). Refer to the dimensions in **Table 1**. If the shaft is worn to the service limit or less, the shaft must be replaced.

Internal Shift Mechanism Inspection

Refer to **Figure 57** for this procedure.

NOTE

Prior to removal or disassembly of any of the components, lay the assembly down on a piece of paper or cardboard and carefully trace around it. Write down the identifying numbers and letter next to the item. This will take a little extra time now but it may save some time and frustration later.

1. Inspect each shift fork for signs of wear or cracking. Check for bending and make sure each fork slides smoothly on the shaft. Replace any worn or damaged forks.

2. Check for any arc-shaped wear or burned marks on the shift forks (B, **Figure 45**). This indicates that the shift fork has come in contact with the gear. The fork fingers have become excessively worn and the fork must be replaced.

3. Measure the inside diameter of each shift fork with an inside micrometer or snap gauge (**Figure 58**). Refer to the dimension listed in **Table 2**. Replace the ones worn to the service limit or greater.

4. Measure the width of the gearshift fork fingers with a micrometer (**Figure 59**). Refer to the dimension listed in **Table 2**. Replace the ones worn to the service limit or less.

5. Check the shift fork dowel pins (**Figure 60**) for wear or damage; replace as necessary.

6. Roll the shift fork shaft on a flat surface such as a piece of plate glass and check for any bends. If the shaft is bent, it must be replaced.

7. Measure the outside diameter of the shift fork shaft with a micrometer. Refer to the dimension listed in **Table 2**. Replace if worn to the service limit or less.

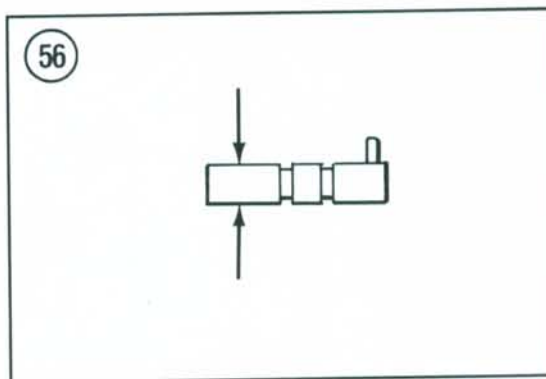
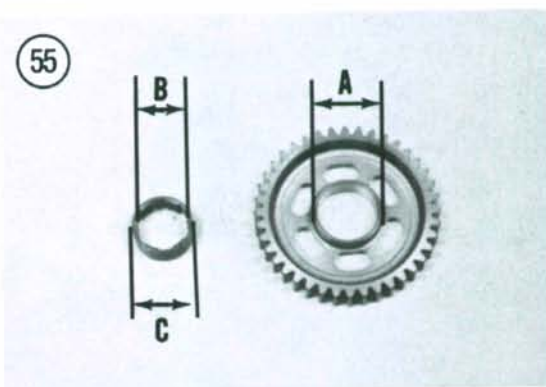
8. Install the shift fork onto its respective gear or shifter (**Figure 61**) and check for uneven wear or damage where the 2 parts mesh. Replace the defective part.

9. Check the grooves in the shift drum (**Figure 62**) for wear or roughness. If any of the groove profiles have excessive wear or damage, replace the shift drum.

10. Check the shift drum bearing (**Figure 63**). Make sure it rotates smoothly with no signs of wear or damage. Replace if necessary.

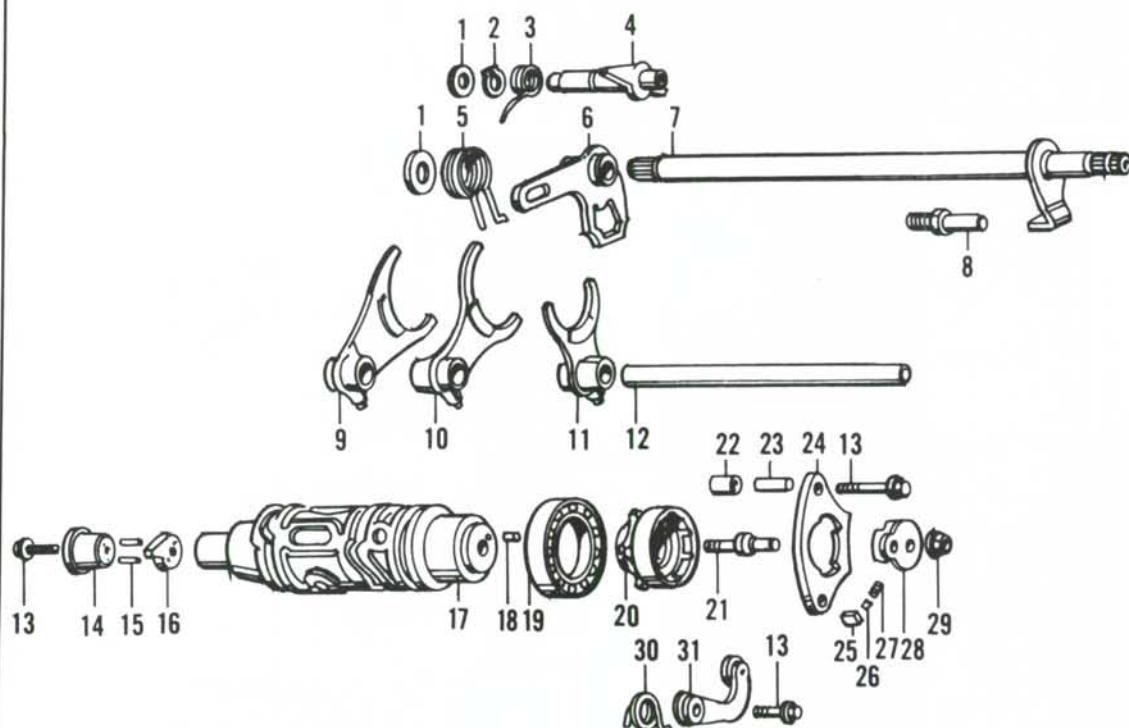
11. Check the notches (A, **Figure 64**) in the drum shifter and the ramps on the stopper plate (B, **Figure 64**) for wear or damage. Replace if necessary.

12. Apply a light coat of oil to the shift fork shaft and the inside bores of the shift forks prior to installation.



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EXTERNAL AND INTERNAL SHIFT MECHANISM



1. Thrust washer

2. Circlip

3. Spring

4. Reverse shaft arm

5. Spring

6. Gearshift arm

7. Gearshift spindle

8. Return spring pin

9. Right-hand shift fork

10. Center shift fork

11. Left-hand shift fork

12. Shift fork shaft

13. Bolt

14. Neutral/reverse rotor

15. Pin

16. Reverse stopper arm

17. Shift drum

18. Pin

19. Bearing

20. Shift drum center

21. Shifter bolt

22. Collar

23. Dowel pin

24. Guide plate

25. Ratchet pawl

26. Plunger

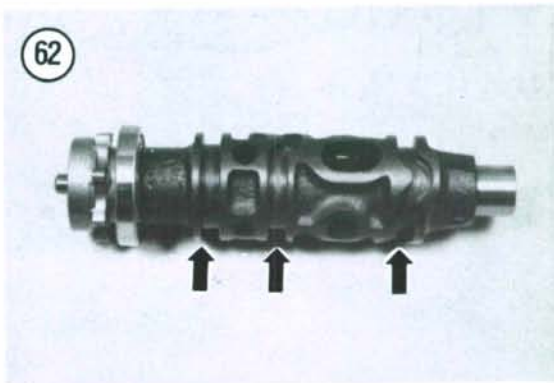
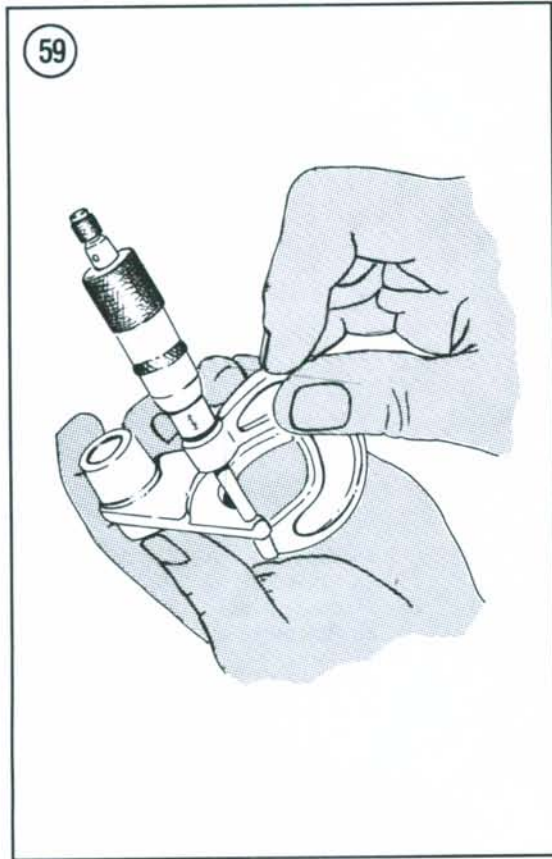
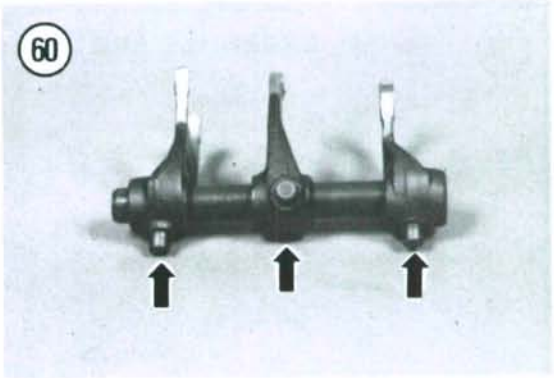
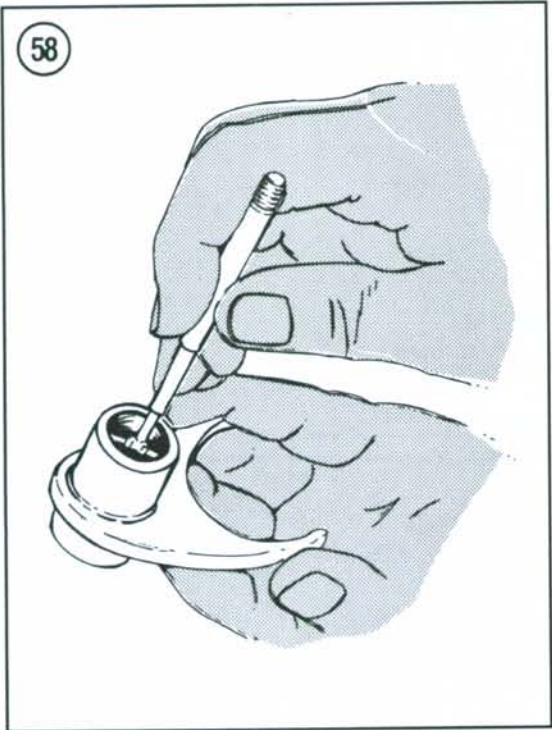
27. Spring

28. Drum shifter

29. Nut

30. Spring

31. Shift drum stopper arm



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